

Role of Social Sciences in Fostering Renewable Energy Technologies Development

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Article Info

Volume 81

Page Number: 5728 - 5734

Publication Issue:

November-December 2019

Article History

Article Received: 5 March 2019

Revised: 18 May 2019

Accepted: 24 September 2019

Publication: 27 December 2019

Abstract

To stabilize carbon dioxide in atmosphere to diminish global warming it is critical to change the nations' energy basic structures. Although, even with an increasing matter of urgency, applying of different source of alternative energy and sources has been sluggish and unreliable. This article argues on the state of the energy studies and discuss the significance and critical role the social sciences could have in emerging energy technologies diffusion and there is a need for energy scientists to be more attentive to the social dimensions of energy systems.

Keywords: Energy, Practice, Renewable Energy Technologies, Social Science

1. Introduction

To have a safe, reliable and low- carbon energy future, the societies need to transform both technologies and human behavior [1]. In order to change the existing high-carbon dioxide (CO₂) energy systems to a low carbon energy techniques that releases low or zero carbon, is crucial to stabilize carbon dioxide in atmosphere to diminish global warming [2]. Today countries' concentration on emissions of green house gas to shrink the threats of change in global climate patterns requires a significant transformation in the energy infrastructure of nation; so far even with an increasing matter of urgency, applying of different source of alternative energy and sources has been sluggish and unreliable[2]. Thus, to attain

stabilizing of global carbon dioxide, a substantial international setting out of alternative energy sources is mandatory [2].

These newly emerging energy technologies are included of both technological and non-technological (societal) sides. Despite the growing necessity of societal side for the energy systems transition, transmission of new energy technologies is slow and unreliable and many complications, not well characterized, exist [3-5]. In this sense, researchers regularly propose technological roots to diffusion of new energies problems while neglecting the social dimensions that determine these emerging energies acceptance in the public, outline the threats they can contain, and facilitate to complete energy policy goals with current

system [6]. This means that, interdisciplinary studies are still hindered due to official barriers both in academic and government sides [1].

As a result, it is critical to consider on the social related reasons for failure of new energy technologies diffusion. In this matter, research indicates that there are different social factors that may hinder or foster the successful accomplishment of new energy technologies such as: socio-political acceptability (acceptance by public, key stakeholders and policy makers) which is generally a clause of technology diffusion and development, and lack of well-trained, educated energy specialists that highlights the significant role of education in development of renewable energy industry [7-9]. Therefore, based on the past reports it is obvious that local and national energy agents are deficient in significant social science expertise, and think as knowledge in other technical fields is superior to social science, although they may affirm that they appreciate what social science offers.

Today, the energy researcher need to learn from business, agriculture and health and combine physical and social research. They need to consider that, energy from the social theory perspective, assuming as a cause or a result of institutional and sociological change, or by way of something which is combined with the foundation of the social order [10]. For the mentioned reasons, the objective of this study is to highlight the significance of social science studies and expertise in diffusion and development of new energy technologies.

2. Energy and Social Practices

Social systems and energy are believed to have mutual relationship with direction of socio-technical advances such as, urbanization patterns, restructuring of manufacturing and

other segments, and arrangements of government. This is ample to establish the prominence of societal dimension in the area of energy and resource management [11]. Today it is believed that “social practices explain patterns of individual or group behavior” and social norms and meanings are shared [12]. Social practice theories propose an integrated model to recognize consumer behavior that is vital to shrinking the environmental effects of industrialized societies and persuading them to use emerging energy technologies more extensively. Indeed, people's sustainable patterns of consumption such as using environmental friendly products or renewable energy technologies, are not believed as a results of individuals values, believes or attitudes, but arising as part of social practices[13].

Generally, social practices state for people's everyday practices and the manner these are habitually and typically performed in (much of) a society. These practices such as cooking, going to work, showering are meaningful to individuals as part of their lifestyle [14]. Social practices involve consumption as performing the respective activities requires the usage of material artifacts as well as resources such as energy and water. Therefore, social practices such as going to work have a huge influence on a society's resource usage and a clear understanding of social practices would increase the potential to encourage behavioral change towards using alternative energy technologies or reduced resource use [15].

In this way, it is recognized that nowadays energy is consumed not only for its particular aim, then also as a kind of, and in the way of undertaking societal habit, cases may include traveling to work, cooking or watching TV [16]. Considering to the link between energy and

practice helps to better understand that, patterns and trends in energy demand is highly relies on realizing how social practices shape, transform and develop[10].

In consequence, a better clarification of the link between energy and society needs to understand the range of practices, social orders and material arrangements in which energy is engaged, as well as how energy flows and material arrangements are involved in the components of practices and hence of society. In this view, the society-energy link, indeed explain that how ‘human caused degradation of nature, reactions to natural environment and ancient artifact maintenance, all happen as instants of scientific, manufacturing, informational, medical and housing practices’[11]. Hypothesizing energy as a component of specific social practices delivers a new perspective which places demand of energy as share of, that cannot discrete from the social practices dynamic nature [17]. Ending this part, deployment of new energies need to reconfigure structure of civilization networks in cities and suburbs, which were formed by the former energy technologies [18]. Likewise, it is argued that major alterations in the energy source are expected to alter societal arrangements, to transform traditional forms of lifestyle and job and devoting advantages and responsibilities otherwise than before [18, 19].

3. Shortcomings of Energy Research

To date, a series of favoritisms continue to hinder energy studies. The consistency of energy models is regularly low as they are over affected by cost assumptions and pay no attention to other key drivers of energy strategy and performance such as societal factors including social equity, politics[20].

Indeed, there are a number of shortcomings associated with energy research that clearly evident in the related literature [21]. Reviewing leading journals indicated three negative reasons related to this issue [20]. Initially, the social aspects are evidently under-examined. Meaning that, the human sides of energy systems and their related characteristics are often overlooked [22]. Indeed, most energy studies have a tendency to center on “state-of-the-art” technological innovations such as hydrogen fuel cells or small modular reactors, and financial analysis, but the significance of cultural, social, political and institutional dimensions has been neglected [2, 23].

The second concern is a ‘disciplinary chauvinism’ which assumes social science less important and peripheral[20]. B. K. Sovacool, confirmed that in a sample, engineering, physical science, statistics and economic accounted for the disciplinary training of 67 percent of authors, on the contrary the remaining of the social sciences, like humanities overall estimated for less than 20 percent (Figure 1). Almost rest of the other majors such as Sociology, history, psychology, philosophy, and communication constituted for approximately 13 percent.

The third pattern is one of homogenous viewpoints. B. K. Sovacool, also stated that more than 80 percent of the research in this issue published by males (Figure1) and be likely to done by Western, rich organizations and states. This disparity makes a problem that most energy research consider the industrialized world while neglecting of such issues as energy poverty, unfair availability of energy services, and gender related problems due to energy usage such as health issues causing by indoor air pollution related to biomass cook stoves [24, 25].

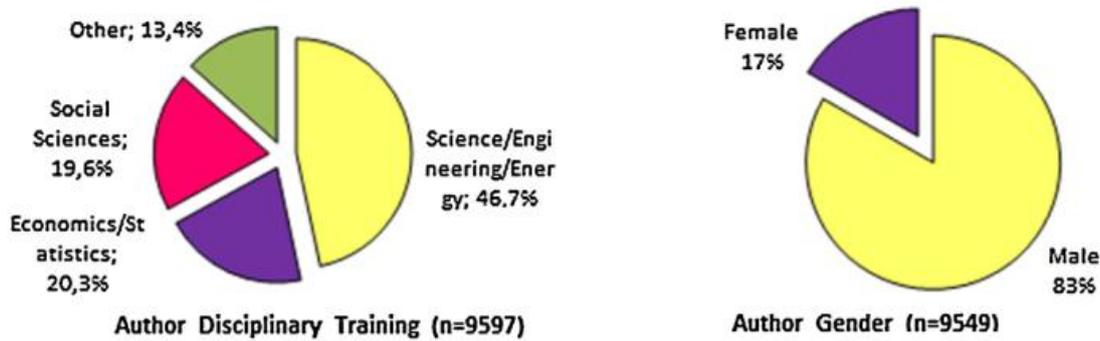


Figure 1: Disciplinary, Gender Trends in Energy Studies, 1999–2013

4. Value of Social Science in Energy Research

Considering on the mentioned shortcomings in energy studies can undoubtedly highlight the critical role social scientists can play to overcome one of the permanent concerns of practical energy studies, the split between technological advances and consumer acceptance of these emerging technologies [26, 27].

Without a doubt, social and political elements extremely control energy outcomes. Considering on countries rely heavily on nuclear power like France, or those who block pipeline construction like Canada and the USA, deliver the meaning that it is not economics or engineering behind this development but social and political factors [28]. To be more precise, it is only social science research that can explain the topics as “What non-economic obstacles exist on the way of early acceptance of environmentally and economically efficient technologies?”, or “what are the solutions that could help to get rid of those impediments?” [28].

In this sense, prior research indicated several interconnected socio-political elements that have potential to be critical to diffusion of

new energy technologies. These potential leading factors is categorized into five main groups: political, regulatory and legal, economic, institutional and social [2, 29, 30]. A country’s political and regulatory setting will undoubtedly sway the key actors in energy technologies area. Indeed, all energy program will be rooted within a country’s competing preferences for resources and so this reason makes political aspects crucial.

Regulatory and legal aspects can also influence diffusion of new energy technology through current and future regulations. For instance, state-specific greenhouse gas mitigation target or setting up a Renewable Portfolio Standard can encourage future of energy policy of a country. A government particular economic laws such as price of electricity, employment issues, urban and rural economic growth, and government business ambience will affect the benefits and costs of a new emerging technology.

Institutional issues contain the regional reliability organizations dispatch policy, the harmony between municipal utilities, investor-owned utilities and rural electric co-operatives, and existing mechanisms of technology transfer. Indeed, the government is the only player in importing or exporting of energy which is

further institutional aspect that affects political environment encompassing energy.

Referring to the societal factors, it should be mentioned that the public and key stakeholders and actors perception of new technologies will be extremely important on the public perception of fairness of the distribution of benefits and risks of the adopted technology. To be sure, each of this components is reliant on others, and there is a dynamic interaction among the factors during the stages of policy development and new technology diffusion.

Ending this part and in order to show the value and significance of social science studies, the article mentions to the two recent study in this matter. Jennings in a study in renewable energy education states that the rapid growth in renewable energy technologies penetration has intensified the problem of a serious deficiency of skilled specialists, with experience in renewable. He confirms that education has a critical role in renewable energy industry diffusion and it accomplishes a number of vital roles including: promoting public awareness of technology, training of technical support staff, initial training of engineers, researchers, scientists and increase of consumer confidence in the technology [9]. In another study, Devine-Wright indicates that public acceptance is a significant issue influencing the extensive implementation of renewable energy technologies and the success of energy policy targets. He also classifies and describes that how personal, psychological and contextual aspects explaining public acceptance [7].

5. Discussion

The studies on behavioral and social science is significantly valuable for systematic energy researcher. Indeed, the possible advantage of social sciences is might be same as the

influence of rebound effects or the importance of supreme emerging energy systems, especially some of which that are difficult-to-understand or contradictory. That is to say, with lack of social scientists to elaborate the associated benefits of such emerging technologies for the public and states' policy makers, their potential magnitude is noticeable only for a few association of researchers and scientists. In this matter, in order to gain a better collaboration between energy research and social science, past research have proposed some practical recommendations. As a starting point, it is for energy policy makers and statistical analyzers to collect, analyze and interpret social science data concerning to the energy matters. Trough problem-centered procedures try to boost interdisciplinary energy-oriented research instead of just conducting a great deal of technology-oriented ones. To inspire an inclusive array of standpoints energy related studies need to include various types of scientists comprising people further than scholars and from all areas over the world. For these reasons there is a need for local and national energy agents and scientists to be more attentive to the social dimensions of energy systems and to explore and fill the gaps that now exist between the social sciences and energy studies.

6. Conclusion

To weigh everything up, energy related studies have become a great deal critical due to the world's increasing concern of climate change and global warming issues. Today is the time for those who are the main player in energy related issues, whether in academia or states to plan more interdisciplinary, socially comprehensive and problem-focused energy studies to achieve to a more effective energy technology deployment. Energy problems

require that social scientists engage with the physical sciences as well as the reverse. As reviewed by this study, the success of renewable energy technologies development can be facilitated by multi-disciplinary social science studies using innovative qualitative and quantitative research methods with a greater stress on societal factors and socially-constructed nature of beliefs about renewable energy systems.

References

- [1] B. K. Sovacool, "Diversity: energy studies need social science," *Nature News*, vol. 511, no. 7511, p. 529, 2014.
- [2] J. C. Stephens, E. J. Wilson, and T. R. Peterson, "Socio-Political Evaluation of Energy Deployment (SPEED): An integrated research framework analyzing energy technology deployment," *Technological forecasting and social change*, vol. 75, no. 8, pp. 1224-1246, 2008.
- [3] K. Neuhoff, "Large-scale deployment of renewables for electricity generation," *Oxford review of economic policy*, vol. 21, no. 1, pp. 88-110, 2005.
- [4] A. Sagar and K. S. Gallagher, "Energy technology demonstration and deployment," *Ending the Energy Stalemate: A Bipartisan Strategy to Meet America's Energy Challenges*, vol. 117, 2004.
- [5] J. C. Stephens, B. Van Der Zwaan, and A. P. Faaij, "The case for carbon capture and storage," *Issues in Science and Technology*, vol. 69, 2005.
- [6] N. W. Biggart and L. Lutzenhiser, "Economic sociology and the social problem of energy inefficiency," *American Behavioral Scientist*, vol. 50, no. 8, pp. 1070-1087, 2007.
- [7] P. Devine-Wright, "Reconsidering public attitudes and public acceptance of renewable energy technologies: a critical review," *Beyond Nimbyism: a multidisciplinary investigation of public engagement with renewable energy technologies*, vol. 15, 2007.
- [8] R. Wüstenhagen, M. Wolsink, and M. J. Bürer, "Social acceptance of renewable energy innovation: An introduction to the concept," *Energy policy*, vol. 35, no. 5, pp. 2683-2691, 2007.
- [9] P. Jennings, "New directions in renewable energy education," *Renewable Energy*, vol. 34, no. 2, pp. 435-439, 2009.
- [10] E. Shove and G. Walker, "What is energy for? Social practice and energy demand," *Theory, Culture & Society*, vol. 31, no. 5, pp. 41-58, 2014.
- [11] T. R. Schatzki, *The site of the social: A philosophical account of the constitution of social life and change*. Penn State Press, 2002.
- [12] T. Schatzki, "Time space and the organization of social life," *Time, consumption and everyday life: Practice, materiality and culture*, pp. 35-48, 2009.
- [13] Røpke, "Theories of practice—New inspiration for ecological economic studies on consumption," *Ecological economics*, vol. 68, no. 10, pp. 2490-2497, 2009.
- [14] A. Reckwitz, "Toward a theory of social practices: A development in culturalist theorizing," *European journal of social theory*, vol. 5, no. 2, pp. 243-263, 2002.
- [15] G. Holtz, "Generating social practices," *Journal of Artificial Societies and Social Simulation*, vol. 17, no. 1, p. 17, 2014.
- [16] A. Warde, "Consumption and Theories of Practice," in *Consumption: Springer*, 2017, pp. 79-101.
- [17] M. Sahakian and H. Wilhite, "Making practice theory practicable: Towards more sustainable forms of consumption," *Journal of Consumer Culture*, vol. 14, no. 1, pp. 25-44, 2014.
- [18] S. Jasanoff and S.-H. Kim, "Socio technical imaginaries and national energy policies," *Science as culture*, vol. 22, no. 2, pp. 189-196, 2013.

- [19] S. Jasanoff and S.-H. Kim, "Containing the atom: Socio technical imaginaries and nuclear power in the United States and South Korea," *Minerva*, vol. 47, no. 2, p. 119, 2009.
- [20] B. K. Sovacool et al., "Integrating social science in energy research," *Energy Research & Social Science*, vol. 6, pp. 95-99, 2015.
- [21] B. K. Sovacool, "What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda," *Energy Research & Social Science*, vol. 1, pp. 1-29, 2014.
- [22] A. Stirling, "Transforming power: Social science and the politics of energy choices," *Energy Research & Social Science*, vol. 1, pp. 83-95, 2014.
- [23] C. Stephens, T. R. Peterson, and E. J. Wilson, "Socio-political evaluation of energy deployment (SPEED): a framework applied to smart grid," *UCLA L. Rev.*, vol. 61, p. 1930, 2013.
- [24] F. Birol, "Energy economics: a place for energy poverty in the agenda?," *ENERGY JOURNAL-CAMBRIDGE MA THEN CLEVELAND OH-*, vol. 28, no. 3, p. 1, 2007.
- [25] S. E. Ryan, "Rethinking gender and identity in energy studies," *Energy Research & Social Science*, vol. 1, pp. 96-105, 2014.
- [26] H. Allcott and M. Greenstone, "Is there an energy efficiency gap?," *Journal of Economic Perspectives*, vol. 26, no. 1, pp. 3-28, 2012.
- [27] H. Allcott and S. Mullainathan, "Behavior and energy policy," *Science*, vol. 327, no. 5970, pp. 1204-1205, 2010.
- [28] Meadowcroft, J. C. Stephens, E. J. Wilson, and I. H. Rowlands, "Social dimensions of smart grid: Regional analysis in Canada and the United States. Introduction to special issue of Renewable and Sustainable Energy Reviews," *Renewable and Sustainable Energy Reviews*, vol. 82, pp. 1909-1912, 2018.
- [29] E. Lachapelle, C. P. Borick, and B. Rabe, "Public Attitudes toward Climate Science and Climate Policy in Federal Systems: Canada and the United States Compared 1," *Review of Policy Research*, vol. 29, no. 3, pp. 334-357, 2012.
- [30] E. Shove, "Beyond the ABC: climate change policy and theories of social change," *Environment and planning A*, vol. 42, no. 6, pp. 1273-1285, 2010.